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Due Date: August 23, 2004

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of:	
Inventor: Arthur W. Wang	Examiner: John J. Lee
Serial #: 09/702,218	Group Art Unit: 2684
Filed: October 30, 2000	Appeal No.: _____
Title: LOW COST DESIGN TO DOUBLE NUMBER OF CHANNELS FOR DIRECT BROADCAST SATELLITE SERVICES	

BRIEF OF APPELLANT

MAIL STOP APPEAL BRIEF - PATENTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

In accordance with 37 CFR §1.192, Appellant hereby submits the Appellant's Brief on Appeal from the final rejection in the above-identified application, in triplicate, as set forth in the Final Office Action mailed February 17, 2004.

Please charge the amount of $330 to cover the required fee for filing this Appeal Brief as set forth under 37 CFR §1.17(c) to Deposit Account No. 50-0494. Also, please charge any additional fees or credit any overpayments to Deposit Account No. 50-0494.

I.   REAL PARTY IN INTEREST

The real party in interest is THE DIRECTV GROUP, INC. the assignee of the present application.

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II. RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences for the above-referenced patent application.

III. STATUS OF CLAIMS

Claims 1-32 and 45-52 are pending in the application.

Claims 12-14 were allowed.

Claims 8, 23, and 32 were objected to.

Claims 1-7, 9, 15-22, 24-31, and 45-52 were rejected under 35 U.S.C. §103(a) as being unpatentable over Castiel et al., U.S. Patent No. 6,678,519 (Castiel) in view of Briskman et al., U.S. Patent No. 6,564,053 (Briskman).

Claims 10 and 11 were rejected under 35 U.S.C. §103(a) as being unpatentable over Castiel in view of Briskman and further in view of Maeda et al., U.S. Patent No. 6,422,516 (Maeda).

IV. STATUS OF AMENDMENTS

Applicant filed an Amendment under 37 C.F.R. § 1.116 on April 19, 2004. The Advisory Action mailed May 12, 2004 does not indicate whether these amendments were entered or not. Because the amendments are unrelated to the issue of patentability and made for purposes of placing the claims in better condition for appeal, the Applicant assumes that the amendments have been entered.

V. SUMMARY OF THE INVENTION

Briefly, Appellant's invention, as substantially recited in independent claims 1, 16, and 24. is described as a system that provides at least near continuous broadcast service to a terrestrial receiver, thus augmenting a legacy satellite constellation in a geostationary orbit. In one embodiment, the system comprises a plurality of satellites (202A-202C) in an inclined, elliptical, geosynchronous orbit. The plurality of satellites (202A,-202C) arguments at least one legacy satellite (204) in a geostationary orbit. These features are illustrated in FIG. 2 and described in the specification as follows:
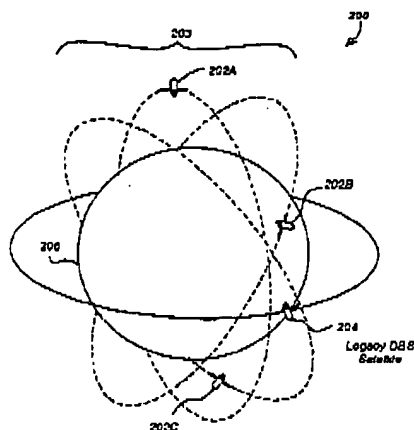
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FIG. 2 is a diagram showing one embodiment of a satellite constellation of an enhanced video distribution system 200 using the principles of the present invention. The enhanced video distribution system comprises one or more legacy satellites 108 in a geostationary orbit around the Earth 206, and an augmenting satellite constellation 203 of three or more satellites 202A-202C (hereinafter alternatively referred to as satellite(s) 202) which are in inclined, substantially elliptical, geo-synchronous orbits with objective service at or near the center of CONUS.

In an embodiment substantially recited in independent claims 7, 22, and 31, the satellites 202A-202C provide a portion of the time of the at least near continuous broadcast service to the terrestrial receiver, and the inclined, elliptical, geosynchronous orbit is characterized by an orbital inclination of about 50 degrees and an orbital inclination of about 0.13.

In another embodiment substantially recited in independent claim 12, the system is described by a receiver station (132) for receiving at least near continuous broadcast service from a plurality of satellites (202A-202C). The receiver station (132) (illustrated in FIG. 1) includes an antenna 112 having a sensitivity characteristic (illustrated in FIG. 4) substantially corresponding to the apparent position of each of the satellites (202A-202C), as shown in FIG. 4 and in the discussion appurtenant thereto (page 7, line 13, et seq.).

In another embodiment substantially recited in independent claim 45, the satellite system is described by at least one satellite in a geostationary orbit (204, and illustrated in FIG. 2), a plurality of satellites, each in an inclined, elliptical geosynchronous orbit (202A-202C), also illustrated in FIG. 2), a

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receiver station antenna 112 that can communicate with said at least one satellite (204) and at least one of said plurality of satellites (202A-202C) during an active period without tracking, and a gateway (104) having a tracking antenna (106) to track said plurality of satellites (202A-202C). This embodiment is described in FIGs. 1, 2, 4, and 6 and the discussion appurtenant thereto.

Finally, in another embodiment substantially recited in independent claim 50, the satellite system is described by at least one satellite (204) in a geostationary orbit, an augmenting constellation (203) of satellites (202A-202C) in non-geostationary orbit, and a receiver station (132) having a relatively high gain, fixed antenna (112) capable of communication with said at least one satellite (204) in a geostationary orbit and an active one of said augmenting constellation of satellites (203). In this embodiment, a track of an apparent position of each satellite of the augmenting constellation of satellites relative to said antenna when said satellite is in an active period is substantially closed loop.

VI. ISSUES PRESENTED FOR REVIEW

Whether claims 1-7, 9, 15-22, 24-31, and 45-52 are patentable under 35 U.S.C. §103(a) over Castiel et al., U.S. Patent No. 6,678,519 (Castiel) in view of Briskman et al., U.S. Patent No. 6,564,053 (Briskman).

Whether claims 10 and 11 are patentable under 35 U.S.C. §103(a) over Castiel in view of Briskman and further in view of Maeda et al., U.S. Patent No. 6,422,516 (Maeda). Arguments for the patentability of each claim are provided below.

VII. GROUPING OF CLAIMS

The rejected claims do not stand or fall together. Separate arguments for the patentability are presented for:

Claims 1, 16, and 24;

Claims 7, 22, and 31;

Claim 9;

Claim 45;

Claim 50; and

Claims 10 and 11.

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VIII. ARGUMENTS

A. The References

1. *The Castiel Reference*

The Castiel reference discloses an elliptical satellite communication system including a constellation of satellites which orbit the earth at a height less than that necessary for geosynchronous orbits but which simulate the characteristics of geosynchronous orbits. The satellites' velocity near the apogee portion of their orbit approximates the rotational velocity of the earth, and during that period appear to hover over the earth. The ground stations on the earth always communicate with a satellite at or near its apogee, and hence that satellite appears to the ground station to hover over the earth. During the times when the satellite is outside the apogee portion, its communication is shut off to prevent any possibility of interfering with geosynchronous satellites and its power supply is used to charge a battery on the satellite. Thus, the power supply of the system can be reduced by an amount equivalent to the percentage of time the satellite is not used.

2. *The Briskman Reference*

The Briskman reference discloses satellite audio broadcasting systems including orbital constellations for providing high elevation angle coverage of audio broadcast signals from the constellation's satellites to fixed and mobile receivers within service areas located at geographical latitudes well removed from the equator.

3. *The Maeda Reference*

The Maeda Reference discloses a system and method for a group of artificial satellites. The artificial satellite is placed into an orbit in which an individual satellite orbits on an elliptical orbit so that at least one of the artificial satellites is always viewable within a pre-defined range of operational elevational angle in a zenith direction from a service area. The group of the artificial satellites are satellites on respective different orbits obtained by combining an inclination angle and an eccentricity squared of the elliptical orbit so that a time period during which one artificial satellite of the group of artificial satellites is viewable from ground is substantially identical to a time period

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during which another artificial satellite of the group of the artificial satellites is viewable from ground.

B. Independent Claims 1, 7, 9, 16, 22, 24, 31, 45, and 50 are Patentable Over the Cited Reference(s)

With Respect to Claims 1, 16, and 24: Claim 1 recites:

A system for providing at least near continuous broadcast service to a terrestrial receiver, comprising:
a plurality of satellites, each satellite in an inclined, elliptical, geosynchronous orbit, each satellite
providing a portion of time of the at least near continuous broadcast service to the terrestrial receiver,
wherein the plurality of satellites augments at least one legacy satellite in a geostationary orbit.

The Final Office Action acknowledges that the Castiel reference does not disclose "the plurality of satellites augments at least one legacy satellite in a geostationary orbit" but asserts that the Briskman reference teaches this limitation in the following passages:

The next analyses take the selected satellite orbit constellation and further optimize it from the viewpoint of orbit perturbations. The purpose of this final optimization is to minimize the satellites' mass, particularly the amount of on-board propellant needed for correcting the orbits from long term perturbations. This is important since both the satellite and its launch vehicle will be less expensive.

The analyses are done by known computer programs. The programs calculate the perturbations of the satellites' orbits caused by the earth's oblateness, the gravity effects of the sun and moon and the solar radiation pressure. Although those effects are individually small on a short term basis, satellites of this type generally have a 15 year lifetime. The magnitude of some of the perturbations are a function of when the satellites are initially placed in orbit (i.e., epoch). The analyses consider which perturbations are additive and which are subtractive, and the minimization of the perturbations by small changes in the initial orbital parameters, particularly inclination and eccentricity, and their subsequent in-orbit correction strategy. The result of the optimization is the amount of satellite on-board fuel required and reflects the minimum satellite mass.

The last analyses involve the optimization of the satellite antenna which is directive towards the service area. The analyses result in the required pointing angle of the satellite antenna boresight with time (i.e., over one sidereal day) to keep it accurately pointed at the service area. Depending on the difference between apogee and perigee altitude, if the apogee is very high, the analyses provide the beamshaping of the satellite antenna with time required to offset the change in range (i.e., space propagation loss change) and also provide antenna pattern rotation requirements with time for antenna beamshapes which are not circular. (col. 5, lines 30-63)

and in FIG. 7 as follows:
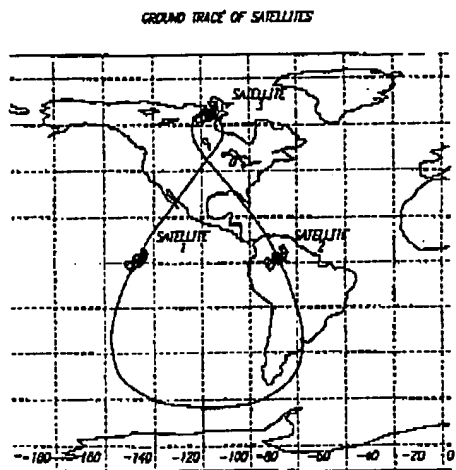
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GROUND TRACE OF SATELLITES

FIG. 7

The Applicant respectfully disagrees with this assessment. The text cited above describes trade spaces that can be considered in optimizing the disclosed (non-geosynchronous) constellation optimization, but it does not describe or suggest that the constellation augments at least one legacy satellite in geostationary orbit. FIG. 7 appears to describe a ground trace for the non-geosynchronous constellation, not a legacy satellite in a geostationary orbit. Therefore, even when combined, the Castiel and Briskman references do not teach the Applicant's invention.

The Advisory Action mailed May 12, 2004, the Examiner argues:

"Briskman teaches [a] geostationary satellite (Fig. 1), which is currently using (means used or heritage satellite because the geo satellite is not a new one) or has been used for broadcasting multimedia signals (see Fig. 1, column 3, lines 20-30, and column 1, lines 37-65) regarding the claimed limitation, provide reducing the cost in [the] satellite system."

The referenced portions of the Briskman reference are reproduced below:

Most of the northern United States has elevation angles in the 30.degree.-35.degree. range which could be lower in practice due to mobile platform tilt. Canada, Japan and most of Europe are at lower elevation angles from optimally located geostationary satellites due to their higher latitudes. FIG. 2 shows the elevation angles for a constellation of three satellites with orbits optimized for the 48 contiguous United States using the methods and techniques of the invention for Bangor, Me.; (col. 3, lines 20-30)

and

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In contrast to the elevation angles of FIG. 1, a satellite constellation of two, three or more satellites can provide during all or most of every day 50.degree.-60.degree. elevation angles throughout a large service area located at high latitudes. The satellites' orbits can also be configured to avoid most of the radiation from the Van Allen belts.

Satellite systems of this invention, in preferred embodiments, serve geographical latitude service areas located at greater than approximately 30.degree. N or 30.degree. S by providing high elevation angles to mobile receivers in such areas for reception of broadcasting transmissions over all or most of the day. The preferred systems use geosynchronous satellites (i.e., having a 24 sidereal hour orbital period--86, 164 seconds) in a constellation. The design of the constellation is configured to optimize the elevation angle coverage of a particular geographical high latitude service area for achieving minimum physical blockage, low tree foliage attenuation and small probabilities of multipath fading. For instance, 13 shows an improvement in foliage attenuation at a 1.5 GHz transmission frequency of many decibels for high service reliabilities when the reception elevation angel is doubled. Such dramatic improvement also occur for other similar improvements occur for other microwave frequencies and for other service reliabilities.

The configuration design optimization is achieved by selection of the orbital parameters of the constellation's satellites and the number of satellites in the constellation. Satellite audio broadcasting systems to mobile receivers generally provide multichannel radio service and the satellite transmissions are nominally between 1-4 GHz. (col. 1, lines 34-65)

The Applicant respectfully disagrees. The satellite constellation disclosed in the Briskman reference cannot be said to augment a legacy satellite in a geostationary orbit. Instead, Briskman's satellite constellation is offered as an alternative to a geosynchronous constellation. This is made clear by the Briskman reference itself because it describes the design of it's constellation without any consideration whatsoever given to the constellation that it supposedly augments:

The configuration design optimization is achieved by selection of the orbital parameters of the constellation's satellites and the number of satellites in the constellation. Satellite audio broadcasting systems to mobile receivers generally provide multichannel radio service and the satellite transmissions are nominally between 1-4 GHz.

Inclination. The inclination of the satellites is generally chosen between about 40.degree. and about 80.degree. so they cover the desired high latitude service areas during their transit overhead.

Eccentricity. The eccentricity is chosen to have a high apogee over the service area so the satellites spend the maximum amount of time overhead. Practically, the eccentricity is limited by the increased distance that the higher is from the service area since this extra distance must be overcome either by higher satellite transmission power, a more directive satellite antenna during this portion of the orbit or combinations thereof. The eccentricity range in preferred embodiments is from about 0.15 to about 0.30. Eccentricities between about 0.15 and about 0.28 are highly preferred since they avoid most of the Van Allen belts.

Planes/Number of Satellites. The number of orbital planes equals the number of satellites, and their spacing at the equator is equal to 360.degree. divided by the number of satellites. Preferred embodiments have satellite constellations between 2 and 4 satellites. To illustrate, for a 3-satellite constellation, the satellites would be in orbital planes separated by approximately 120.degree..

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Argument of Perigee. For service to latitude areas above 30.degree. N, the argument of perigee is in the vicinity of 270.degree. so that the apogee is in the northern hemisphere and the perigee is in the southern hemisphere. For service to latitude areas below 30.degree. S, the argument of perigee is in the vicinity of 90.degree. so that the apogee is in the southern hemisphere and the perigee is in the northern hemisphere.

Longitude of the Ascending Node. The orbit planes are chosen with a longitude of the ascending node such that the satellites have a good view (i.e., are at high elevation angles as viewed by mobile receivers) of the complete service area. Generally, this is accomplished by choosing the right ascension of the ascending node and the mean anomaly such that the center of the ground trace bisects the service area.

Ground Trace. In the preferred embodiment, the satellites follow the same ground trace and pass over a given point on the earth at approximately equal time intervals. The orbit of each satellite occupies its own orbital plane. For satellites in neighboring planes in a constellation of n satellites, the difference in right ascensions of the ascending nodes is 360.degree./n, the difference in mean anomalies is 360.degree./n and the average time phasing between the satellites on the trace is 24 sidereal hours/n.

Orbit Control. Satellite constellations of this invention experience change in the aforementioned orbital parameters over time due to the earth's oblateness, gravity forces of the sun, moon and solar radiation pressure. These can be compensated by the satellites' on-board propulsion system. The amount of such propulsion can be minimized by analyzing the perturbations of each individual orbit parameter over the lifetimes of the satellites caused by the previously mentioned effects and choosing the initial conditions of the orbits so the minimum on-orbit changes are required. This choice is generally assisted by the fact that some perturbation sources partially cancel out others.

Satellite Spatial and Time Diversity. FIG. 3 shows the elevation angle coverage from Seattle, WA to a three-satellite constellation optimized by the methods described herein for broadcast service to the United States of America. Two satellites are visible at all times. The techniques for satellite spatial and time diversity described in U.S. Pat. No. 5,319,672 dated Jun. 7, 1994; U.S. Pat. No. 5,278,863 dated Jan. 11, 1994 and U.S. Pat. No. 5,592,471 dated Jan. 7, 1997 are fully applicable, and these patents are incorporated herein by reference.

The satellite transmission power margin saved by using the invention for mitigation of multipath fading and for reduction of tree and foliage attenuation can be used to advantage. One use is by employing a smaller, less costly satellite. A second use is by transmitting more program channels. (col. 1, line 59 - col. 3, line 12)

and

The important analysis input parameters are the definition of the geographical service area and the quality of service to be provided. The quality of service is defined as the percent of time service will be unavailable due to outage from physical blockage, multipath and tree/foliage attenuation. The desired satellite elevation angles for minimizing outage from single path physical blockage can be derived from calculations similar to those graphically shown in FIG. 14. Similarly, the desired satellite elevation angles for minimizing outage from tree/foliage attenuation can be derived from transmission measurements in the projected service area at the system's operating radio frequency, such as shown in FIG. 13 for the United States at L-band frequencies, and knowledge of the satellites' transmission signal margin at the mobile receiver. Multipath and total blockage (i.e., all path blockage such as occurs when a mobile receiver passes under a large underpass) are dealt with by use of satellite spatial and time diversity. Diversity is analyzed as a requirement of the number of satellites simultaneously viewable by the mobile receivers and of the satellites' elevation angles.

The results of the aforementioned analyses are then used in the design of the satellite constellation which is a function of the orbital parameters and number of satellites in the constellation. Using known computer analysis programs, an optimization is performed of the elevation angles for the mobile receivers throughout the service area to the constellation's satellites throughout a day (i.e., since the satellites are geosynchronous, the elevation

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angles will repeat every day if perturbations are ignored). The optimization specifically varies inclination and eccentricity for given right ascensions to maximize the time the satellites remain over the service area (i.e., at high elevation angles). Also, the choice of the apogee and perigee of the orbit considers the avoidance of passage through the Van Allen belts so radiation damage to the satellites is minimized and avoids too high apogees so excess space loss or antenna beam forming is minimized as discussed subsequently.

Continuous coverage of a reasonably sized service area well removed from the equator cannot be achieved with a single satellite so analysis is generally performed on constellations with 2, 3 and 4 satellites. The analyses are performed using known computer programs. The amount of elevation angle coverage improvement diminishes for constellations with more than three satellites. Constellations with more than 4 satellites are technically feasible and only marginally improve both elevation angle coverage and redundancy. FIG. 8 shows the elevation angle coverage of a two satellite constellation as seen from New York City. No appreciable satellite spatial diversity is possible making multipath mitigation from this technique unavailable. The selection of the number of satellites in the constellation from the analyses' data is based on the criteria adopted for the minimum required number of satellites visible to mobile receivers throughout the service area at the selected minimum elevation angles. The selection may also be influenced by system costs.

The next analyses take the selected satellite orbit constellation and further optimize it from the viewpoint of orbit perturbations. The purpose of this final optimization is to minimize the satellites' mass, particularly the amount of on-board propellant needed for correcting the orbits from long term perturbations. This is important since both the satellite and its launch vehicle will be less expensive.

The analyses are done by known computer programs. The programs calculate the perturbations of the satellites' orbits caused by the earth's oblateness, the gravity effects of the sun and moon and the solar radiation pressure. Although those effects are individually small on a short term basis, satellites of this type generally have a 15 year lifetime. The magnitude of some of the perturbations are a function of when the satellites are initially placed in orbit (i.e., epoch). The analyses consider which perturbations are additive and which are subtractive, and the minimization of the perturbations by small changes in the initial orbital parameters, particularly inclination and eccentricity, and their subsequent in-orbit correction strategy. The result of the optimization is the amount of satellite onboard fuel required and reflects the minimum satellite mass.

The last analyses involve the optimization of the satellite antenna which is directive towards the service area. The analyses result in the required pointing angle of the satellite antenna boresight with time (i.e., over one sidereal day) to keep it accurately pointed at the service area. Depending on the difference between apogee and perigee altitude, if the apogee is very high, the analyses provide the beamshaping of the satellite antenna with time required to offset the change in range (i.e., space propagation loss change) and also provide antenna pattern rotation requirements with time for antenna beamshapes which are not circular.

Two systems using this invention were designed for audio satellite broadcasting. One system was designed for service to the contiguous 48 United States. The input requirements were to have one satellite in the northern portion of the service area always in view with at least 60.degree. elevation angle to mobile receivers in the area and a second satellite always visible with at least 25.degree. elevation angle. The analyses were conducted with an orbital computation program called "Satellite Tool Kit" from Analytical Graphics, Inc. of Malvern, Pa. The results of the analyses resulted in a three satellite constellation. FIGS. 2 through 7 show specific final elevation angle coverage outputs of the program for the system.

A second system was designed for service to Europe using similar input requirements to the first system and the same computation program. FIGS. 9 through 12 reflect the final results regarding elevation angle coverage. (col. 4, line 31 - col. 5, line 67)

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Simply put, other than impermissible hindsight reconstruction, there is no suggestion that the Briskman satellites are anything other than independent from those in geosynchronous orbit.

With regard to a teaching to combine the Castiel and Briskman references, the Final Office Action indicates that "it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the Castiel system as taught by Briskman. The motivation does so [sic] would be to achieve optimum using satellite and reducing cost in satellite system."

The Applicant respectfully disagrees. Castiel itself recites the disadvantages in geosynchronous systems, as described below:

> The inventors of the present invention have noted a number of drawbacks associated with geosynchronous ("geo") satellite systems. One major drawback is the cost to raise a satellite into a geo orbit. Geosynchronous orbit occurs at around 36,000 kilometers. The cost to boost the satellite into orbit is directly proportional to the height of the orbit. Therefore, it is expensive to boost a satellite into geosynchronous orbit. This cost must be amortized over the lifetime of the satellite, making geo satellites very expensive.
>
> Another problem results from the geometry of coverage of a geosynchronous satellite system. A three satellite geostationary satellite system could have the satellites spaced equally along the equator, at 120 degree intervals. Their limit of visibility on the equator is calculated from the relationship:

$$2\{\cos^{-1}(R_E/a_{geo})\}=2\{\cos^{-1}(6378/35786)=2\{79.73deg\}=159.47deg.$$

> where 6378 is the radius of the earth in kilometers, and 35786 is the radius out to the geostationary ring. Taking difference between the above value and 120 degrees, it is clear that there is approximately 40 degrees of overlapping coverage by two adjacent geo satellites for an observer on the equator. There will be even less at greater latitudes. Many global services, however, require world-wide transmission of their information to the whole world. Since each of the satellites only covers one part of the world, some other way must be used to disseminate the information from the source to the satellites covering the rest of the world.
>
> The information begins its transmission at a link. That link transmits up to the satellite in orbit, which then retransmits the information to communicate to, or "cover" one portion of the earth. The same information must also be transmitted to another of the satellites to cover another part of the earth. The information is either sent: 1) over a land line between the link on the earth and ground stations that service areas for the other satellite(s), or 2) via satellite-to-satellite transmission. The land link requires additional equipment and expense. The satellite link also requires additional equipment, but in addition operates a transmission across the two ends of the 42,000 kilometer equilateral triangle. This requires a transmission which is some 70,000 kilometers long. This system requires a second antenna on each of the satellites in addition to complicating control and pointing structure. Even then, the long communication channel may cause noise in the channel.
>
> One of the most difficult-to-solve problem results from the geometry of the geosynchronous orbit. There is only one available orbital position ("band") for geosynchronous satellites. This band is already saturated with satellites. Satellites occupy the geo band with only 2 degrees of spacing therebetween. These are referred to as orbital "slots". Most of the slots are now occupied, making it difficult to find positions for any more geostationary satellites. However, other satellite locations cannot be allowed to interfere with the communication to the geo satellites when operating at the same frequencies.

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The system of the present invention obtains the advantages of geosynchronous satellites without using the high altitude circular orbit normally used for geo satellites. The present invention uses a plurality of satellites in orbits chosen such that each desired point of coverage on the earth communicates with a different satellite at different times, and in a direction of antenna pointing separated angularly from any geo satellite(s), such that there is no radio frequency interference, even when operating at the same frequency as a geo satellite. Thus, the present invention alleviates the present "geo-slot" problem. The lower altitudes of the present invention also lead to smaller link distances from ground-to-satellite and from satellite-to-satellite, decreasing the power required due to path loss. These lower altitudes also decrease the time delay which can be annoying in voice transmissions. Thus, the present invention provides a unique solution to some of the problems of using geo satellites. (col. 1, line 42 – col. 2, line 30).

As is apparent from a review of the passages reproduced above, the Castiel reference teaches an alternative to a geostationary legacy constellation, not one that augments such a constellation.

Indeed, the Castiel reference teaches that interaction between legacy geostationary constellations is regarded as undesirable "interference," and thus, expressly teaches away from the combination suggested by the Final Office Action.

Claims 16 and 24 recites features analogous to those of claim 1 and is patentable for the same reasons.

<u>With Respect to Independent Claims 7, 22, and 31</u>: Claim 7 recites:

A system for providing at least near continuous broadcast service to a terrestrial receiver, comprising:
a plurality of satellites, each satellite in an inclined, elliptical, geosynchronous orbit, each satellite providing a portion of time of the at least near continuous broadcast service to the terrestrial receiver, wherein the orbit is characterized by an orbital inclination approximately equal to 50 degrees and an eccentricity approximately equal to 0.13.

According to the Final Office Action, this feature is disclosed in the Castiel reference as follows:

The "inclination" I is the angle between the orbital plane of the satellite and the equatorial plane. Prograde orbit satellites orbit in the same orbital sense (clockwise or counter-clockwise) as the earth. For prograde orbits, inclination lies between 0.degree. and 90.degree.. Satellites in retrograde orbits rotate in the opposite orbital sense relative to the earth, so for retrograde orbits the inclination lies between 90 degrees and 180 degrees.

The "critical inclination" for an elliptical orbit is the planar inclination that results in zero apsidal rotation rate. This results in a stable elliptical orbit whose apogee always stays at the same latitude in the same hemisphere. Two inclination values satisfy this condition: 63.435.degree. for prograde orbits or its supplement 116.565 degrees for retrograde orbits. (col.. 6, lines 24-36)

The foregoing discloses the selection of an orbital inclination to provide a zero apsidal rotation rate, namely 63.435 degrees. With out further explanation, the Applicant does not

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understand how an orbital inclination 50 degrees will provide a zero apsidal rotation rate (Castiel suggests otherwise). Therefore, in this respect at least, it is not clear how a 50 degree inclination can be thought of as "substantially equal" to a 63.435 degree inclination.

The same conclusion results when the selected inclination is viewed from the perspective of the Applicant's invention. Selecting an inclination and an eccentricity approximately equal to 50 and 0.13 provides CONUS coverage for an 8 hour period, and eliminates sudden shifts in the apparent position of the active satellite, as described below:

FIG. 3 is a diagram illustrating the ground track 302 of the orbit of the satellite 202 specified in Table I, centered at the geographical center of CONUS for an 8-hour period when the satellite is providing broadcast services to a subscriber. The outside rings 304 show 57 degree elevation contours at 10 minute intervals within the active period. Note that all of CONUS (all 48 states) are covered within the 57 degree elevation angle. The ground track 302 of the orbit of the satellite 202 is a closed loop in a (reversed) teardrop shape. This eliminates sudden shifts in the apparent position of the active satellite (as the task of transmitting the broadcast signal is shifted from a first satellite (e.g. 202A) to a second satellite (e.g. 202B) in the constellation) and thus allows an IRD 132 with a fixed (non tracking) receiver station antenna 112 to receive uninterrupted service from the satellite constellation.

Without further explanation, it is not clear to the Applicant how Castiel's value of 63.435 degrees is substantially equal to the 50 degree value recited in claim 7. Briskman, at col. 2, lines 10-14, teaches that the eccentricity should be approximately 0.15 to 0.30, not 0.13. Accordingly, the Applicant respectfully traverses this rejection.

Claims 22 and 31 recite features analogous to those of claim 7, and are patentable on the same basis.

<u>With Respect to Claim 9</u>: Claim 9 recites:

A receiver station for receiving at least near continuous broadcast service from a plurality of satellites in an inclined, elliptical, geosynchronous orbit, comprising:
an antenna having a sensitivity characteristic substantially corresponding to the track of the apparent position of each of the satellites.

According to the Final Office Action, the foregoing is disclosed as follows:

The satellites follow repeating ground tracks, since the cycle of satellite movement shown in FIGS. 4A-4F continually repeats. Importantly, this allows the ground tracking antenna 212 to continually follow the same path, starting at a beginning point, tracking the satellite, and ending at the coalesce point. After the satellites coalesce as shown in FIG. 4A, the antenna begins its tracking cycle.

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The inventors of the present invention have optimized this system for preventing interference with geo satellites.

Specifically, consider FIG. 4G which shows a multiplicity of satellites in inclined elliptical orbits. The present invention preferably operates to monitor satellites at and near their apogee positions. The satellites near perigee are moving too rapidly, and hence are not tracked. More generally, the system of the present invention operates such that the satellites are only being used at certain times during their orbits. In this preferred embodiment, those certain times are when the satellites are at apogee. Non geosynchronous circular arrays are commonly used at present; they are actually much less efficient, since with zero eccentricity they spend a significantly greater time on the side of the earth away from the populated continents. The arrays of the present invention, on the other hand, spend most of the time at or near apogee over the populated continents of interest, and a relatively small time (at high angular velocities) passing through perigee in regions of no commercial interest. (col. 11, line 63 – col. 12, line 22, emphasis added)

The Applicant respectfully disagrees. As indicated by the bolded text above, the foregoing teaches a *tracking* antenna (e.g. one that tracks the satellites as they move in apparent position). This teaches away from an antenna having a sensitivity characteristic that does not require satellite tracking (e.g. one with a sensitivity characteristic corresponding to the apparent position of each of the satellites).

<u>With Respect to Claim 45</u>: Claim 45 recites:

A satellite system comprising:
at least one satellite in a geostationary orbit;
a plurality of satellites, each in an inclined, elliptical geosynchronous orbit;
a receiver station antenna that can communicate with said at least one satellite and at least one of said plurality of satellites during an active period without tracking, and
a gateway having a tracking antenna to track said plurality of satellites.

According to the Final Office Action, the foregoing is taught by Castiel in view of Briskman under the same rationale as claim 1. The Final Office Action further indicates that Castiel further discloses a receiver station that can communicate with at least one satellite and at least one of said plurality of satellites during an active period without tracking as described below:

The video input to be distributed is received as video input 200, and input to a video coder 202 which produces digital coded video information. This digital coded video is multiplexed with a number of other channels of video information by video multiplexer 204. The resultant multiplexed video 206 is modulated and appropriately coded by element 208 and then up-converted by transmitter element 210. The up-converted signal is transmitted in the Ku band, at around 14 GHz, by antenna 212. Antenna 212 is pointed at the satellite 100 and received by the satellite's receive phased array antenna 214. Antenna 212 is controlled by pointing servos 213.

The received signal is detected by receiver 216, from which it is input to multiplexer 218. Multiplexer 218 also

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receives information from the inter-satellite transponders 240.

The output of multiplexer 218 feeds the direct transponders 250, which through a power amplifier 252 and multiplexer 254 feeds beam former 256. Beam former 256 drives a transmit, steerable phased-array antenna 260 which transmits a signal in a current geo frequency band to antenna 262 in the remote user terminal 106. This signal preferably uses the same frequency that is used by current geo satellites. The phased array antenna is steered by an on-board computer which follows a pre-set and repeating path, or from the ground. This information is received by receiver 264, demodulated at 266, and decoded at 268 to produce the video output 270. (col. 9, lines 1-27)

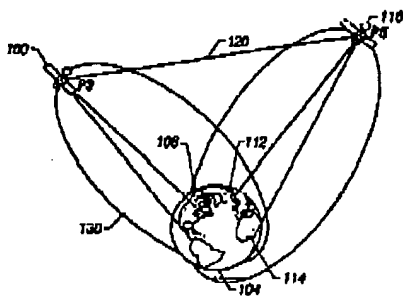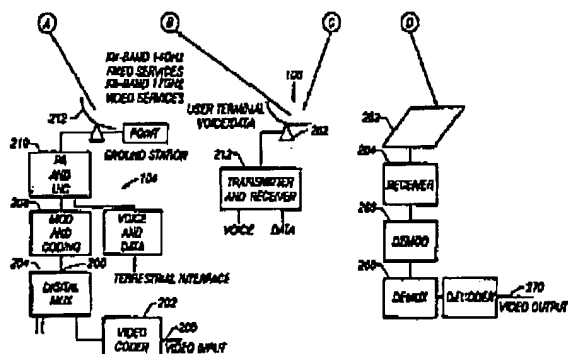and in the FIGs. 1 and 2, reproduced below:

FIG. 1

FIG. 2-2

The Applicant respectfully disagrees. Nothing in the foregoing teaches a receiver station that can communicate with said at least one satellite and at least on of a plurality of satellites during an active period without tracking. As described above with regard to the Applicant's independent claims, Castiel teaches the use of a tracking antenna at the receiver station. The Applicant believes that the majority of the text relied upon by the Final Office Action refers to the transmitting satellite, and what little refers to the receiver station does not describe the features recited in claim 45. Accordingly, the Applicant respectfully traverses this rejection.

With Respect to Claim 50: Claim 50 recites:

A satellite system, comprising:
at least one satellite in a geostationary orbit;
an augmenting constellation of satellites in non-geostationary orbit, and
a receiver station having a relatively high gain, fixed antenna capable of communication with said at least one satellite in a geostationary orbit and an active one of said augmenting constellation of satellites,

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wherein a track of an apparent position of each satellite of the augmenting constellation of satellites relative to said antenna when said satellite is in an active period is substantially closed loop.

According to the Final Office Action, claim 50 is unpatentable for the same reasons as claim 1. In addition, the Final Office Action indicates that the Castiel reference discloses a fixed antenna capable of communication with said at least one satellite in a geostationary orbit as follows:

> This system has a number of other distinct advantages. Importantly, the system operation allows selecting specific geographic locations to be preferentially covered; for example, continents can be followed by the constellation to the exclusion of other areas, e.g. ocean areas between the continents. The communication equipment on the continent always communicates with one satellite at apogee, although not always the same satellite. From the point of view of the ground station, the satellite appears to hover over the ground.
>
> This satellite system operates virtually like a geosynchronous satellite system. Importantly, these satellites according to the present invention orbit at about half the altitude of the geo systems. A geo orbit orbits at 36,000 miles altitude: the virtual geo satellite orbits at average altitudes of 16-18,000 miles. Also, geo satellites require "apogee motors", to boost them from their original orbits into the final geo orbit. These apogee motors can double the weight of the satellite.
>
> This yields a communications system which costs less dollars per launch capability because of the reduced weight to boost and less size. Also, since the geo satellites orbit at a higher altitude, they operate at a higher power, and use a larger illuminating antenna, all other conditions on the ground being equal. These satellites also have a much larger overall size. This size of the satellites increases as the square of the distance. Therefore, the geo satellite needs to be at least twice as large and twice as powerful as a low altitude satellite. The power supply conservation techniques of the present invention allow the satellite to be made even smaller.
>
> The system also provides satellites with very high elevation angles. Maximizing the elevation angle prevents interference with existing satellites such as true geosynchronous satellites.
>
> This is another feature of the present invention which allows these satellites to operate in ways which avoid any possibility of interference with the geo band. (col. 4, lines 12-48)

However, as described above, Castiel discloses a system that requires a tracking antenna. Hence, claim 50 is allowable as well.

C. Dependent Claims 2-6, 10-11, 15, 17-21, 25-30, 46-49, and 51-52 are Patentable Over the References of Record

Claims 2-6, 10-11, 15, 17-21, 25-30, 46-49, and 51-52 each include the limitations of the claims they depend upon and are patentable on the same basis. In addition, claims 2-6, 10-11, 15, 17-21, 25-30, 46-49, and 51-52 recite features rendering them even more remote from the cited references.

Particularly, the Final Office Action rejects claims 10-11 as unpatentable over Castiel in view of Briskman and further in view of Maeda. The Applicant respectfully traverses this rejection. Claim 10 recites:

The receiver station of Claim 9, wherein the receiver antenna comprises a reflector having a focal line and a focal point on the focal line and a head, wherein the head is disposed offset from the focal point.

According to the Final Office Action, these features are disclosed in the following portion of the Maeda reference:

True Anomaly .theta.: angle defined by the line connected between the perigee and the focal point of the ellipse and the line connected between the satellite and the focal point of the ellipse (shown by symbol 58 in FIG. 5) (0 degrees <= theta <= 360 degrees).

The geometrical relationship for those elements will be described with reference to FIGS. 5 and 6. The satellite 51 moves on the elliptical orbit having a focal point 50. The distance between the perigee 53 of the ellipse and the focal point 50 of the ellipse is represented by perigee radius Rp and with symbol 57 in FIG. 5. The distance between the apogee 52 of the ellipse and the focal point 50 of the ellipse is represented by apogee radius Ra and with symbol 56 in FIG. 5. Perigee radius, apogee radius, semi-major axis a represented by symbol 54 in FIG. 5, semi-minor axis b represented by symbol 55 in FIG. 5 and the eccentricity squared c have the following relations.

$$Rp=a(1-e)$$
$$Ra=a(1+e)$$
$$B=a(1-e^2)^{1/2}$$
$$e=(Ra-Rp)/(Ra+Rp)$$

In FIG. 6, what is shown is an example in which the earth 60 is positioned at the focal point of the elliptical orbit. The elliptical orbit crosses at the north-bound node 62 on the equational plate from the southern hemisphere to the northern hemisphere, while the perigee is positioned at the point 65 and the apogee is positioned at the point 66. The angle 64 between the equational plate 61 and the orbital plane defines the orbital inclination angle i. The right ascension of the north-bound node is defined by the angle 68 measured in the eastern direction from the vernal equinoctial point, and the argument of the perigee is defined by the angle 63 between the north-bound node 62 and the perigee 65.

Even if the semi-major axis can be specified definitely by the orbit cycle, other major parameters may be determined to be arbitrary values, such as the eccentricity squared is an arbitrary real number 0.0 or over and less than 1.0, the orbital inclination angle is an arbitrary real number 0.0 degree or over and 180 degrees or smaller, and the argument of perigee is an arbitrary real number 0.0 degree or over and 360 degrees or smaller. Thus, there may occur a situation in which a designer is forced to determine values for those parameters intuitively and/or empirically from his or her experiences.
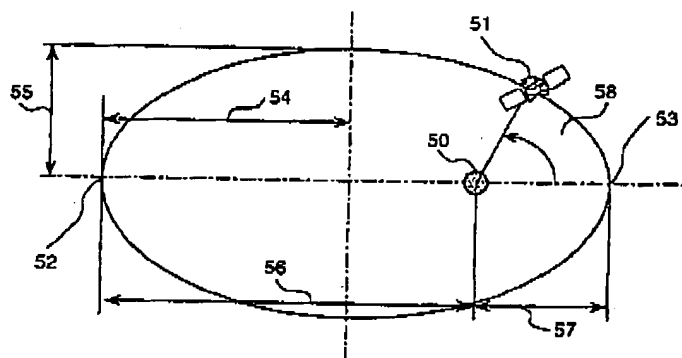
If a satellite which can come in sight in the zenith direction for an extended period of time on the upper air of the target service area can be realized, "large-scale data transfer from mobile bodies for an extended period of time" can be established by satellite communications. Thus, what has been sought are feasible methodologies for defining orbit-related elements and their definite values which can be adaptive to Japanese territory

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characteristics and are cost-effective, that is, configured with less number of satellites forming the overall system.

As described above, in order to transfer large-scale data including image files from movable bodies, like an automobile, for an extended period of time, it is required to make the satellite remain on the orbit in the zenith direction as long as possible and to communicate with the satellite.

It has been generally recognized that it is preferable to establish an orbit shaped in an oblong ellipse having its apogee on the upper air of the target service area, in order to satisfy the above described requirement. However, adequate methodologies and algorithms for defining orbit-related elements have not been proposed. In addition, there is no definite proposal for specified values for those parameters to be optimized for the services over the whole Japanese land.   (col. 4, line 17 – col. 5, line 16)

FIG.5

Respectfully, the Applicant cannot ascertain where the foregoing even remotely teaches the features recited in claims 10 and 11. The Applicant further disagrees that there is any teaching or suggestion to modify Castiel/Briskman as described in Maeda.

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IX. CONCLUSION

In light of the above arguments, Appellant respectfully submit that the cited references do not anticipate nor render obvious the claimed invention. More specifically, Appellant's claims recite novel physical features which patentably distinguish over any and all references under 35 U.S.C. §§ 102 and 103. As a result, a decision by the Board of Patent Appeals and Interferences reversing the Examiner and directing allowance of the pending claims in the subject application is respectfully solicited.

Respectfully submitted,

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APPENDIX

1.   A system for providing at least near continuous broadcast service to a terrestrial

receiver, comprising:

a plurality of satellites, each satellite in an inclined, elliptical, geosynchronous orbit, each satellite

providing a portion of time of the at least near continuous broadcast service to the terrestrial receiver,

wherein the plurality of satellites augments at least one legacy satellite in a geostationary orbit.

2.   The system of Claim 1, wherein the plurality of satellites comprises a first satellite

actively servicing the terrestrial receiver, and a second satellite, wherein an apparent position of the

second satellite relative to the terrestrial receiver is substantially proximate the apparent position of the

first satellite relative to the terrestrial receiver when the first satellite completes providing its portion of

the broadcast service.

3.   The system of Claim 1, wherein a track of the apparent position of each of the satellites

relative to the terrestrial receivers when the satellite is providing its portion of the at least near

continuous broadcast service is substantially closed loop.

4.   The system of Claim 3, wherein the terrestrial receiver comprises an antenna having a

sensitivity characteristic substantially corresponding to the track of the apparent position of each of the

satellites.

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5.   The system of Claim 3, wherein the track of the apparent position of each of the satellites substantially corresponds to a sensitivity pattern of an antenna at the terrestrial receiver.

6.   The system of Claim 1, wherein a track of the apparent position of each of the satellites relative to the terrestrial receivers when the satellite is providing its portion of the at least near continuous broadcast service is substantially teardrop-shaped.

7.   A system for providing at least near continuous broadcast service to a terrestrial receiver, comprising:

a plurality of satellites, each satellite in an inclined, elliptical, geosynchronous orbit, each satellite providing a portion of time of the at least near continuous broadcast service to the terrestrial receiver, wherein the orbit is characterized by an orbital inclination approximately equal to 50 degrees and an eccentricity approximately equal to 0.13.

8.   The system of Claim 7, wherein the orbit is further characterized by a period approximately equal to 86164 seconds, an altitude at perigee approximately equal to 30305 kilometers, and an altitude at apogee approximately equal to 41268 kilometers.

9.   A receiver station for receiving at least near continuous broadcast service from a plurality of satellites in an inclined, elliptical, geosynchronous orbit, comprising:

an antenna having a sensitivity characteristic substantially corresponding to the track of the apparent position of each of the satellites.

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10. The receiver station of Claim 9, wherein the receiver antenna comprises a reflector having a focal line and a focal point on the focal line and a head, wherein the head is disposed offset from the focal point.

11. The receiver station of Claim 10, wherein the head is disposed offset from the focal line.

12. A receiver station for receiving at least near continuous broadcast service from a plurality of satellites in an inclined, elliptical, geosynchronous orbit, comprising:

an antenna having a sensitivity characteristic substantially corresponding to the track of the apparent position of each of the satellites,

wherein the receiver antenna comprises a reflector having a focal line and a focal point on the focal line and a head, wherein the head is disposed offset from the focal point, and wherein the head is disposed offset from the focal line, and

wherein the reflector is approximately 18 centimeters in diameter, and the head is disposed approximately 7 inches offset from the focal point and approximately 4 inches offset from the focal line.

13. The receiver station of Claim 12, further comprising a second head disposed substantially at the focal point.

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14. The receiver station of Claim 13, wherein the second head receives signals from a geostationary satellite.

15. The receiver station of Claim 9, wherein the plurality of satellites comprises a first satellite actively servicing the receiver station, and a second satellite, wherein the apparent position of the second satellite relative to the receiver station is substantially proximate the apparent position of the first satellite relative to the receiver station when the first satellite completes providing its portion of the broadcast service.

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16.   A method of providing at least near continuous broadcast service to a terrestrial receiver, comprising the steps of:

providing a signal having a portion of the continuous broadcast service from at least one of a plurality of satellites at a time, each satellite in an inclined, elliptical, geosynchronous orbit, and

providing service from at least one legacy satellite in a geostationary orbit.

17.   The method of Claim 16, wherein the plurality of satellites comprises a first satellite actively servicing the terrestrial receiver, and a second satellite, wherein an apparent position of the second satellite relative to the terrestrial receiver is substantially proximate the apparent position of the first satellite relative to the terrestrial receiver when the first satellite completes providing its portion of the broadcast service.

18.   The method of Claim 16, wherein a track of the apparent position of the each of the satellites relative to the terrestrial receivers when the satellite is providing its portion of the at least near continuous broadcast service is substantially closed loop.

19.   The method of Claim 18, wherein the terrestrial receiver comprises an antenna having a sensitivity characteristic substantially corresponding to the track of the apparent position of each of the satellites.

20.   The method of Claim 18, wherein the track of the apparent position of each of the satellites substantially corresponds to a sensitivity pattern of an antenna at the terrestrial receiver.

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21. The method of Claim 16, wherein a track of the apparent position of the each of the satellites relative to the terrestrial receivers when the satellite is providing its portion of the at least near continuous broadcast service is substantially teardrop-shaped.

22. A method of providing at least near continuous broadcast service to a terrestrial receiver, comprising the steps of:

providing a signal having a portion of the continuous broadcast service from at least one of a plurality of satellites at a time, each satellite in an inclined, elliptical, geosynchronous orbit, wherein the orbit is characterized by an orbital inclination approximately equal to 50 degrees and an eccentricity approximately equal to 0.13.

23. The method of Claim 20, wherein the orbit is further characterized by a period approximately equal to 86164 seconds, an altitude at perigee equal to approximately 30305 kilometers, and an altitude at apogee approximately equal to 41268 kilometers.

24. A method of receiving at least near continuous broadcast service at a terrestrial receiver, comprising the steps of:

receiving a signal having a portion of the continuous broadcast service from at least one of a plurality of satellites at a time, each satellite of the plurality of satellites being in an inclined, elliptical, geosynchronous orbit, and

receiving broadcast service from at least one legacy satellite in a geostationary orbit.

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25. The method of Claim 24, wherein the plurality of satellites comprises a first satellite and a second satellite and wherein the step of providing a signal having a portion of the continuous broadcast service from at least one of the plurality of satellites at a time comprises the steps of:

receiving a signal from the first satellite actively servicing the terrestrial receiver; and

receiving a signal from the second satellite when the apparent position of the second satellite relative to the terrestrial receiver is proximate the apparent position of the first satellite relative to the terrestrial receiver.

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26.   The method of Claim 24, wherein the plurality of satellites comprises a first satellite actively servicing the terrestrial receiver, and a second satellite, wherein an apparent position of the second satellite relative to the terrestrial receiver is proximate the apparent position of the first satellite relative to the terrestrial receiver when the first satellite completes providing its portion of the broadcast service.

27.   The method of Claim 24, wherein a track of the apparent position of the each of the plurality of satellites relative to the terrestrial receivers when the satellite is providing its portion of the at least near continuous broadcast service is closed loop.

28.   The system of Claim 27, wherein the terrestrial receiver comprises an antenna having a sensitivity characteristic corresponding to the track of the apparent position of each of the plurality of satellites.

29.   The system of Claim 27, wherein the track of the apparent position of each of the plurality of satellites corresponds to a sensitivity pattern of an antenna at the terrestrial receiver.

30.   The method of Claim 24, wherein a track of the apparent position of each of the plurality of satellites relative to the terrestrial receivers when the satellite is providing its portion of the at least near continuous broadcast service is teardrop-shaped.

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31.   A method of receiving at least near continuous broadcast service at a terrestrial receiver, comprising the steps of:

receiving a signal having a portion of the continuous broadcast service from at least one of a plurality of satellites at a time, each satellite in an inclined, elliptical, geosynchronous orbit, wherein the orbit is characterized by an orbital inclination equal to 50 degrees and an eccentricity equal to 0.13.

32.   The method of Claim 31, wherein the orbit is further characterized by a period equal to 86164 seconds, an altitude at perigee equal to 30305 kilometers, and an altitude at apogee equal to 41268 kilometers.

33. – 44.   (CANCELED)

45.   A satellite system comprising:

at least one satellite in a geostationary orbit;

a plurality of satellites, each in an inclined, elliptical geosynchronous orbit;

a receiver station antenna that can communicate with said at least one satellite and at least one of said plurality of satellites during an active period without tracking, and

a gateway having a tracking antenna to track said plurality of satellites.

46.   The satellite system of Claim 45, wherein each satellite of the plurality of satellites is an active satellite during an active period, and a track of the apparent position of each active satellite relative to the receiver station antenna is substantially closed loop and when an active satellite is nearing

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the end of the active period, the apparent position of the active satellite substantially overlaps another one of the plurality of satellites that is beginning the active period.

47.   The satellite system of Claim 46, wherein a beamwidth of said tracking antenna of said gateway is sufficient to encompass both said active one and said another one of said plurality of satellites.

48.   The satellite system of Claim 46, wherein apparent positions of the plurality of satellites are spatially separated from the apparent position of the at least one satellite in geostationary orbit to avoid interference.

49.   The satellite system of Claim 48, wherein the angular separation between the plurality of satellites and at least one satellite in geostationary orbit is at least thirty degrees.

50.   A satellite system, comprising:

at least one satellite in a geostationary orbit;

an augmenting constellation of satellites in non-geostationary orbit, and

a receiver station having a relatively high gain, fixed antenna capable of communication with said at least one satellite in a geostationary orbit and an active one of said augmenting constellation of satellites,

wherein a track of an apparent position of each satellite of the augmenting constellation of satellites relative to said antenna when said satellite is in an active period is substantially closed loop.

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51.   The system of Claim 50, wherein apparent positions of said augmenting constellation of satellites is sufficiently disposed away from the apparent position of said at least one satellite in a geostationary orbit to avoid interference.

52.   The system of Claim 50, wherein the closed loop shape of the apparent position of said satellite in an active period substantially coincides with a teardrop sensitivity pattern of said antenna.

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